Can a synergetic cooperation between telecom and utility network providers lead to a faster rollout of fiber to the home networks?

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Abstract— **Telecommunication networks should be seen as the next utility network, comparable to electricity, water or gas, due to the large similarities in rollout and operational management of all these networks but also as a necessary condition in enabling every person who so wishes to participate fully in the information society, despite individual or social disadvantages. This paper details the approach and first research results of the TERRAIN (Techno-Economic Research for futuRe Access Infrastructure Networks) project, which focuses on a synergetic cooperation between telecom and utility network providers as well as municipalities and other involved actors (vendors, SME's, etc.).**

Keywords - next generation access; FTTH; synergetic rollout; multi-actor analysis

I. INTRODUCTION

For telecom operators, migrating to an all fiber access network, which would open up huge bandwidths to the customers, is one bridge to far. Clearly this is caused by the fact that the replacement of the telecom access network infrastructure is a very costly project, certainly when infrastructure competition is fierce and dedicated networks must be deployed. Additionally new investments in utility networks mostly imply large civil works which disrupt traffic and cause frustration for inhabitants and local retailers. The rollout and upgrade of these networks are seldom synchronised, nor are the continuous operations in a later stage such as repair and maintenance processes. When the different utility network owners of roads, sewerage, drinking water, gas, electricity and telecom can be pursued to close cooperation, large synergies and considerable savings could be obtained. Especially when telecom operators or municipalities would make a long-term planning for future telecom (open) access networks (fiber to each premises), and could combine their rollouts with other utility networks, a faster and more cost efficient rollout could be guaranteed (economies of scale and scope), which will benefit the whole society.

The TERRAIN project (http://www.terrainproject.be/), which stands for "Techno-Economic Research for futuRe Access Infrastructure Networks" is a Flemish project in the IBBT ICON framework, and deals with finding synergies and opportunities between all current/potential actors involved in the rollout of new telecom and utility infrastructure in order to stimulate and speed up new fiber access network rollouts. In the following section we will elaborate more on the TERRAIN project focus. In section III, IV and V the first results from the project are presented in three actions: possible ways to reduce and share costs, how an open access structure can stimulate competition, and recommendations towards all actors involved in the rollout of FTTH. In section IV a short conclusion is drawn.

II. TERRAIN PROJECT FOCUS

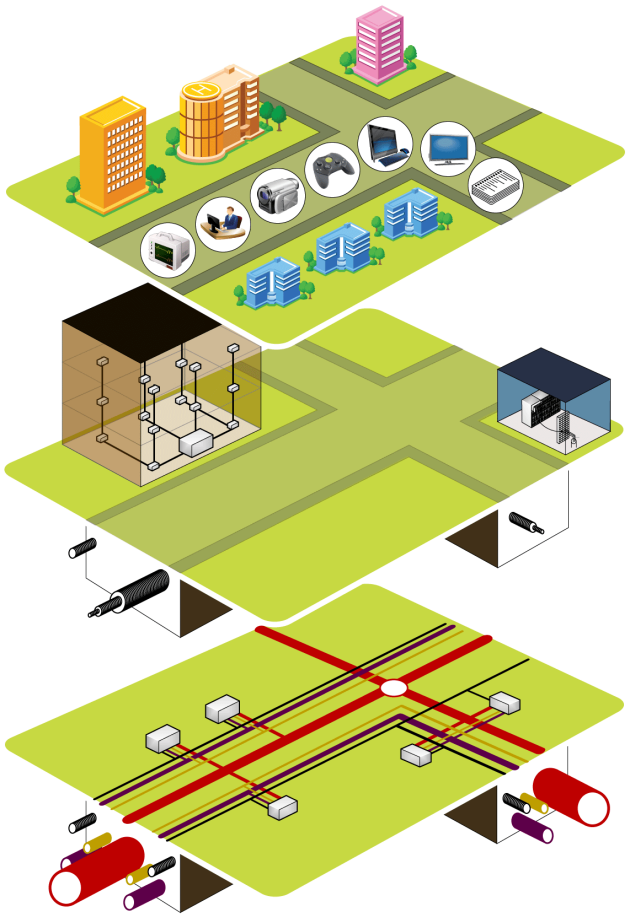
Figure 1 shows all these steps taken into account in the course of the TERRAIN project. The central figure gives an overview of the different layers of a next generation access network. At the bottom we find the physical infrastructure layer, where the main focus of the project is on savings and sharing installation with as many parties as possible, which clearly involves other infrastructures. Cooperation between different utility owners will benefit most during the rollout phase of the new access network infrastructure. The cost for digging comprises more than half of the overall project's total cost of ownership when considering a dedicated network rollout [1]. Combining effort will reduce the cost per partner involved as only one trench is required (width and depth of the trench depending on the type and number of access networks considered). Many synergy opportunities, leading to a more efficient and faster rollout of access infrastructure, are possible if all actors involved could cooperate. Defining new cooperation models requires a thorough investigation of the current value networks including the roles and actors involved in every stage of the rollout and operational processes. On the other hand, the additional coordination time and cost should not be forgotten, but this will be limited compared to the potential benefits.

Business Modeling & Public Policy

- Aligning all roles and actors involved in this complex value network
- Which cooperation and competition models are feasible?
- Identifying potential involvement of municipalities and their return?
- How does this all matches with current and future regulation?

User Requirements & Business Opportunities

- Defining market and user requirements (residential, business, governmental)
- Which market potential and user adoption can be reached, taking into account timing aspects?
- How could we improve current policies for bridging the digital divide?



In-building Networks

- Synergies of infrastructures, e.g. in entering the building and first installation
- Technology and migration roadmap for telecom in-building networks

Telecom Access Infrastructure

- Roadmap for future-proof technology solutions
- Defining heuristics for cost-efficient network architectures
- Proposing cost allocation schemes for installing new telecom access networks

Physical Infrastructure

- Potential synergies between different utility infrastructure networks? How can they be optimized?
- Search for communal network rollout strategies
- Development of network modeling and design tools
- Proposing fair cost allocation schemes
- Combining all available GIS data for more accurate network and cost calculations

Extended economic feasibility analysis

- Detailed CapEx, OpEx and (in)direct revenue modeling
- Extending the currently used traditional investment evaluation methods with multi-actor analysis
- Modeling competition (using game-theory) and strategic decisions (using real options techniques)

Figure 1: TERRAIN project overview

On top of that, the telecom network infrastructure and equipment layer should be provided. We would like to propose a future proof telecom network solution, with competition opportunities in terms of network access and service innovation. Therefore technical decisions within the telecom access and in-building networks (e.g. number of fibers, technology choice, point-to-point or point-to-multipoint architecture, etc.) are being evaluated in terms of the overall value network proposition (such as network ownership, number of potential operators, investment and risk sharing, and regulatory issues).

The highest layer considers the services, applications and gains of a next generation network. Services which require high capacity bandwidth offered, with a likely quick adoption uptake and high ARPU (average revenue per user) are listed and evaluated in the light of residential, government and business user potential.

Next to the more technical issues, a large focus within this project is put on the socio-economic analysis, including public benefits, policy and regulatory aspects, and value network analysis. Public-private partnership opportunities are being investigated, in terms of how the different partners can or should cooperate, co-finance and exploit the new rolled out fiber to the home (FTTH) network, with the most appropriate business model(s) for the local situation, taking into account local, national as well as European legislation concerning public involvement. An comprehensive cost/benefit model, taking into account all previous considerations (technical, regulatory, value network), is created to show the benefits for all actors involved in the deployment and exploitation of the new telecom infrastructure. The extensive economic feasibility studies will make use of advanced evaluation techniques such as sensitivity, multi-actor, real options and game theoretic analysis.

Finally, the combination of technical solutions, combined with value network, regulatory and economic analysis, will be used to formulate and evaluate some best practices and recommendations towards utility and telecom network operators, municipalities, as well as guidelines for future regulation, a technology migration roadmap for access and in-building networks, cooperation and competition models, and valorisation opportunities.

Within the next three sections we will show the first results from the TERRAIN project.

III. Potential ways for reducing and sharing costs

Telecom could well become the next utility as rolling out a new network involves tremendous costs which no telecom operator is gladly willing to take under uncertainty of take rate and usage. Where at a 100% take rate many areas could provide a positive business case for rolling out an FTTH network, which is the case for all utility networks where one access connection per customer per type of utility is foreseen, this will in many occasions not be the case in telecom due to infrastructure competition where take rates of 50% or less are typical (e.g. in case of a duopoly like in Belgium).

Clearly sharing the physical infrastructure could greatly increase the chances of an FTTH rollout. To ameliorate the case of FTTH even more, a public-private partnership can be constructed in which a municipality or other public actor can investment. European and Belgian legislation need to be considered for next generation access network rollouts as the limitations for public funding are clearly stipulated [2]. This research also clearly identifies the situations in which public funding can be allowed.

Apart from investments, public bodies and especially legislative authorities can also use legislation to force infrastructure owners to cooperate closer. In the case of many cities in Belgium, some kind of recommendation is already in place which forces utility infrastructure providers to cooperate in case road works are required. Legislation could go further and restrict opening the roads in specific areas to specific time-slots, force the infrastructure owner at work to put in one extra empty duct, etc.

Within the TERRAIN project, the research extends this work and investigates how the economics of the rollout will be impacted by a joint digging and installation of the infrastructure (either utility and/or telecom). We showed in [3] how a combined network rollout (telecom, gas and electricity) could lead to a reduction in overall trenching costs up to 56% and considering installation and equipment of the underground cabling, an overall 14%-17% savings per actor can be obtained, making use of a fully allocated cost allocation model. Other schemes are being investigated e.g. based on the actor managing the project, involvement of the municipality, etc. These first results already indicate that enormous costs can be saved.

A geo-marketing approach can be used for finding out which areas should benefit from public stimulation most and which areas could be left to regular competition [4]. The concept of geo-marketing is introduced. This method helps selecting the best set of customers to connect in order to "maximize" its business case, which can depend case by case e.g. for a private operator this will be customers with a high ARPU, for a city the digital divide might be target group.

IV. Open access is the way to competition

Most municipal FTTH networks share the fact that the network infrastructure is opened at a given location to all possible operators, who can connect customers to their services over the shared physical connection. European legislation restricts municipalities or other public actors to invest (at the same conditions as private investors) only in physical infrastructure, meaning trenching, ducting, fiber and in some cases also the splitters. In an open access network, the infrastructure can then be opened to private operators (e.g. via tender procedures, mainly the case for wholesale or on bilateral agreements) and can thus get direct access to the communication medium up to the customer. Clearly as mentioned on the physical layer, this means that network operators can use the fiber directly to the customer from some distant location, typically the central office, at a reasonable price. Open access is not restricted to the physical layer, however, and access can be given at higher layers as well.

Opening up the network at the physical layer allows having a high take rate, in case all current customers in Belgium

switch to FTTH this amounts to over 80% of all houses compared to multiple nationwide covered infrastructures with only a take rate of 40% in a duopoly situation. This clearly will lower the prices per connection. Opening the network at the physical layer gives the highest flexibility on what to offer to the customer considering technology determining bandwidth, service level agreements, etc.

When the network is opened at the network layer, either Ethernet or IP level, service providers can rent bandwidth to the customer and as such easily provide services to the customers. When bandwidth is opened at a fair and bargained price, many service providers can very easily deploy new services. The TERRAIN project has identified a large set of services which are waiting for the higher bandwidth offered in an FTTH network to emerge [5][6]. An expert survey indicated the most interesting cases to consider, of which the potential is currently being investigated in a large scale survey in Flanders and Ghent. These include health monitoring, content storage and management, desktop sharing and online gaming.

Opening the network at both these levels will thus clearly increase competition, stimulate innovation and open up the field for many new and dedicated services, as indicated by several European cases. This all will lead to a higher customer value at a lower price.

V. Recommendations towards the different actors

As mentioned before municipalities can impose ways in which road works are/should be coordinated and allowed, and as such stimulate cooperation and joint installations. However, imposing restrictions could also hinder, through obstructive administration, the willingness to start with an FTTH rollout. Local public bodies, such as municipalities, counties, etc. are optimally placed to also facilitate the rollout of broadband. When possible, they can look for changes to the administrative process or simplifications to the regulation allowing faster administrative handling of new installations (e.g. granting rights of way). Additionally local or national regulators can unambiguously define their regulatory course and actions within the European regulatory context.

Facilitation of the broadband rollout could also come from clarification on the questions considering technology choice and installation. Especially in the case of in-building installations, a more standardized high bandwidth network rollout procedure based on single mode fiber and a better estimation of the cost structure could lead to a higher fiber installation, especially in the case of multi-dwelling units. This in turn will facilitate any later coupling of a FTTH network [7].

Finally a better view on the different actors and actively involving them in the rollout, network infrastructure, services and final applications will also facilitate the rollout of an FTTH access network. We showed in [8] the important actors for the rollout of an FTTH network. The case of the municipal FTTH network of Stockholm is considered from this multi-actor point of view and learned us a lot on how to facilitate the cooperation of the different actors [9]. Within TERRAIN, other important municipally driven FTTH network rollouts, such as Amsterdam, Almere, and Nuenen are investigated for the actors involved, their incentives, regulatory and legislative context and the applicability on the Belgian situation.

VI. Conclusions

Fiber to the home will provide a very high bandwidth connection to the customers and can as such be used to provide novel and innovative services from which the residential customers, governmental and business users, and overall society could gain a lot. Still the huge investments required for rolling out this new infrastructure hinder the deployment in the Belgian context. The TERRAIN project investigates possible approaches and actions to take away these obstructing factors and find technical and economically viable business cases for a sustainable FTTH deployment.

Within this paper we have described the current main findings of the TERRAIN project and focused these on three actions:

1. Potential ways for reducing and sharing costs amongst the different actors
2. How an open access structure can stimulate competition
3. Recommendations towards the different actors

Working on these three actions, a municipality can in synergy with other infrastructure owners and in close cooperation with network and service providers, technology vendors, etc. reduce installation costs (especially per customer), take away hindering factors and stimulate innovation by opening up the road for new advanced value adding services. As such, a synergetic approach initiated by the municipality and other public and private actors could provide the tipping point for starting and operating a sustainable FTTH rollout.

Some best practices and recommendations will be formulated and evaluated in the upcoming months towards utility and telecom network operators, municipalities, and other involved actors in order to stimulate the rollout of FTTH within a long-term sustainable techno-economic framework.

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